Avoiding Sample Collisions with Puck Visualization for MX

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We have created a Convolutional Neural Network (CNN) meant to prevent dangerous collisions within the dewar located at the National Synchrotron Light Source II (NSLS-II) AMX beamline. Our data consists of 1,041 images of B5 SPINE style base housed in Uni-Pucks under liquid nitrogen. These images are separated into three categories, straight, tilted, or empty, depending on the condition of the cap.

An image is taken using the area detector through the Experimental Physics and Industrial Control System (EPICS). After getting the image, each cap is cropped to its own image at its own position. This image is sent through the CNN to predict if the cap is safe for the autonomous robotic gripper. The CNN is composed of three hidden convolutional layers with max pooling between each layer for feature extraction. A flatten and dense layer are used to condense the matrix into a usable vector before being input into the final dense layer for classification.

Using the samples collected, the CNN model described above was able to achieve over ninety percent accuracy in predicting the cap condition. Although the model can predict three important cap conditions, to make a more robust program, we plan on adding obstruction categories as we continue data collection. Future categories, such as ALS caps and loose pins within the puck, will add further protection for the autonomous robotic gripper and allow for safer data collection.